

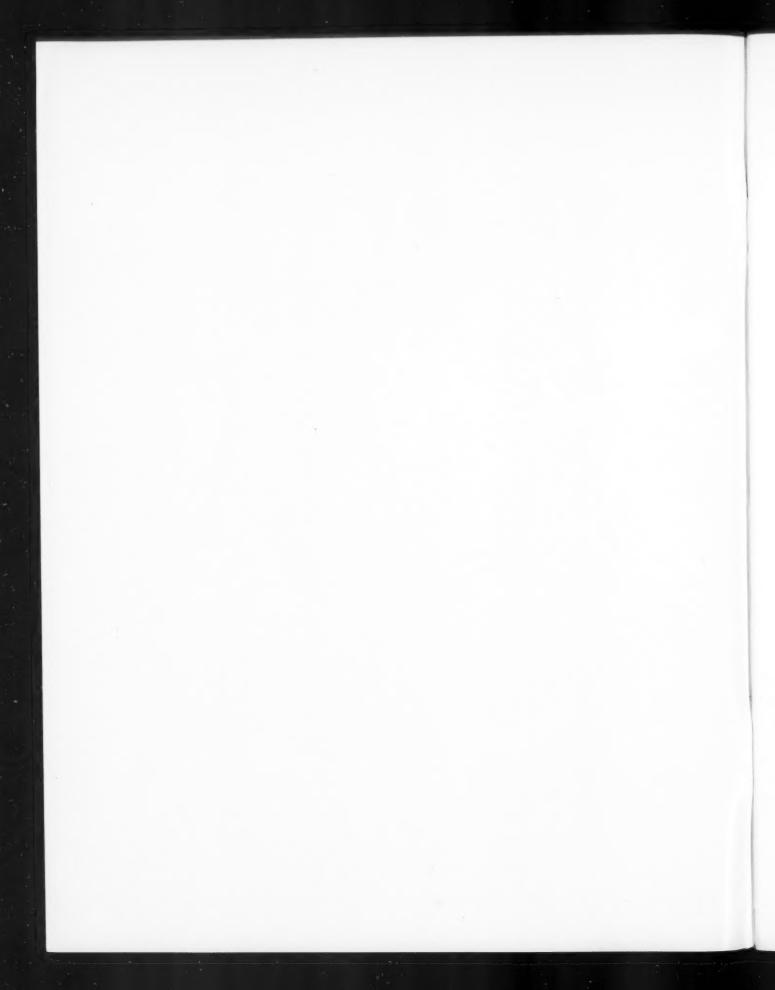
Journal of Methods-7ime Measurement

In This Issue . . .

MTM Conference

Apply Pressure Research

Guide for Safe Location of Buttons on Positive Type Clutch Punch Presses



MTM

The Journal of Methods-Time Measurement

May-June 1958

The <u>Journal of Methods-Time Measurement</u> is dedicated to the technical aspects, application developments and general news items concerning the advancement of MTM.

The Journal encompasses the fields of endeavor that were formerly publicized in the MTM Newsletter and MTM Bulletin.

The technical section of the Journal is concerned chiefly with recent research developments both from the established research program at the University of Michigan, Ann Arbor, Michigan, and from somewhat smaller allied projects being conducted throughout the Association membership.

New applications of MTM as well as refinements of established applications are presented in the Application Section to illustrate specific approaches to management problems that can be solved through the use of Methods-Time Measurement.

Current events in the lives of persons associated with MTM are described in the general news section.

The Editorial Staff welcomes contributions for all three sections described.

MTM

The Journal of Methods-Time Measurement

May-June 1958

MTM Association Editor..... Richard F. Stoll

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TECHNICAL I

INSTRUMENTATION USED IN A LABORATORY STUDY OF APPLY PRESSURE

by

Barbara Ettinger Goodman, Research Assistant and James Foulke, Student Assistant Engineering Research Institute - University of Michigan

The problem of investigating "Apply Pressure" centers around the determination of its nature, of the variables which do and do not affect it, and of the time necessary to perform this element. As a starting point for this experiment, the definition of Maynard, Stegmerten, and Schwab from their book, Methods - Time - Measurement was used. This definition states that Apply Pressure is a momentary hesitation during which force is applied to overcome the effects of resistance which are too great to be overcome by a normal motion. In order to learn more regarding this matter, it is necessary to conduct both a laboratory and an industrial study from which data is gathered, analyzed, and studied. The purpose of this paper is to discuss the instrumentation of the laboratory phase of this experiment into the nature of Apply Pressure.

Before any definite instrumentation could be utilized, it was necessary to determine the form in which the data would be most desirable. It was decided that both qualitative and quantitative information would be needed in order to give a true picture of an Apply Pressure. We felt that the qualitative information should be a picture of the instantaneous force exerted by the subject and the quantitative data should tell us the starting and ending points of this same application of pressure. Therefore the form we thought best for the data to take was one of the main factors influencing the design of the equipment used in the laboratory study. Another major consideration was that of validity. Our apparatus would have to enable us to measure the pertinent parts of applied pressure to the desired accuracy. Furthermore, it was thought important that we should be able to make the necessary changes from one situation to another easily and quickly so that flexibility was one more goal to be considered. Because we wished the subjects to apply a wide range of forces during the course of the laboratory experiment, the apparatus needs be sensitive and sturdy enough to withstand any pressure which the subject might exert. Sturdiness and sensitivity therefore became further objectives in design. One more quality wanted from the apparatus was reliability. This was perhaps a most selfish consideration since

the thought of frayed and frazzled nerves from tempermental equipment was not appealing. Finally, because our budget was not unlimited, we strove consciously and unconsciously to be as economical as we could without jeopordizing our results. In summary, the form of the data and the qualities of validity, flexibility, sturdiness, sensitivity, reliability, and economy were the factors taken into consideration in the design of the equipment.

The experimental situation can be seen in Figure 1

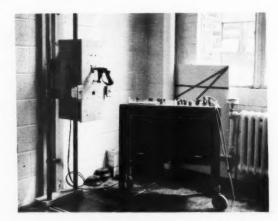


Fig. 1

To the left is the apparatus on which the applied pressure is performed and in the center is the Sanborn recorder on which the information obtained from the apparatus to the left is recorded on two channel Sanborn recording Permapaper. The graphs are recorded on this special paper through the action of a heated stylus which melts a chemical on the surface of the paper. This setup gives us a permanent record which is not subject to the messiness and erasibility of a pen and ink record. The applied pressure apparatus is clamped on two parallel bars which are two inches in diameter and six feet long and allow for adjustment to various heights. The switches on either side of the front panel are used during the experimental operation described below. The apparatus is pictured with one of the levers

mounted. This particular handle is supported on a shaft which permits it to move foreward or backward, i.e., it may be pushed or pulled by the subject. The force applied is transmitted via a bar in the center of the panel to a measuring mechanism. In addition to the lever pictured, the panel serves as a mounting for a push button, a squeezable lever, a horizontal bar lever, and a palm lever, all of which are variables in the experiment.

At the start of an operation, the left switch is in an up position and the right switch is down. The subject performs the continuous cycle of grasping (flicking is outlawed) one switch, moving it down if it's up or vice versa, pushing the lever, then grasping the other switch and moving it up when it is down or vice versa. After the subject has become familiar with an operation and is working with a smooth steady rhythm, we turn on the Sanborn recorder and start gathering data.

Perhaps you are asking yourself why the switches were included as a part of the procedure and why we are so particular about the way the subject handles them? The purpose of the switches is threefold. First of all, since an Apply Pressure generally appears as one element in a whole group of motions, we wanted this same situation present in our study. Secondly, we wanted to divert some of the subject's attention away from the lever and so the switches were added to take the spotlight periodically from it. Thirdley, because we wanted to record a series of at least ten cycles at one time, we needed some assurance that the subject would begin each cycle with about the same level of muscular tension in his arm. We wanted to eliminate residual muscular tension from the previous application of pressure. If the subject were just pushing (or pulling) the lever without performing fine motions afterward, there would be no stimulus for him to release most of the tension previously built up. By requiring the subject to grasp a switch and move it up (or down) we are in essence requiring a release of most of the stored tension; and this release was not obtained by flicking the switch which is a gross motion.

The following MTM Analysis is presented only to give you an idea of one of the motion patterns which our subjects use in the course of the experiment. However, as we change the levers mounted on the apparatus, the weights suspended on the bell crank situated behind the panel, the position of the subject in relation to the lever, and the amount and kind of lever travel, the motion pattern also changes to some

extent. Furthermore, it should be remembered that the MTM analysis was made independent of any laboratory findings. More important, what is being done in the laboratory is not influenced by this analysis. This last comment particularly applies to Element 3.

The lever mounted on the apparatus during this analysis is the one pictured in Figure 1. Also, there was no weight suspended on the bell crank at that time. The subject stood facing the panel with her right arm in line with the lever. Moreover, the angle between her upper arm and forearm was about 90 degrees.

With the analysis (see following page) we are now in a position to discuss the instrumentation which made this analysis possible.

The term, "Apply Pressure," implies the relationship of force versus time. In order to measure this relationship, it is convenient to record force as a function of time on a resistance strain gage recorder. These instruments detect strain in terms of a small resistance change in a resistive element which is applied to the specimen under test. This resistance change is then compared electrically (in a bridge circuit similar to that of the Wheatstone bridge) to a known resistor which allows the change to become a direct measure of the force applied to the specimen.

In solving the problem of recording force as a function of time, it became necessary to develop a mechanical system whereby force could be conveniently measured with resistive strain gages. The bell crank shown in Figure 2 proved to be a satisfactory solution to the problem.

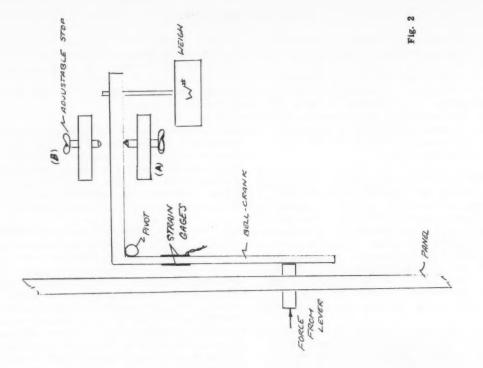
In the apparatus as pictured the bell crank is fastened to a panel on which the lever under test is mounted. A short bar passing through the panel transmits to the bell crank the force applied to the lever under test. The strain thus produced is recorded as a force on the recorder.

The weight suspended on the freely pivoting bell crank provides the desired resistance to the force associated with Apply Pressure. Using this arrangement we are able to alter resistive forces easily. After the required pressure has been developed the system will commence to move. The stops (A & B) limit the distance the lever moves to the controllable increments demanded by the experiment.

In analyzing Apply Pressure (Fig. 3 top) it was found that in order to precisely locate the beginning and end of the cycle, it would be desirable

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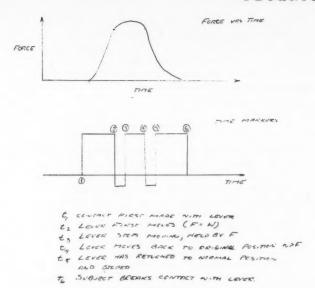


Fig. 3

to know when the subject first established complete contact with the lever under study. If you have ever worked with a sensitive bridge circuit, you know that if you make contact with a part of the ungrounded circuit, a measurable unbalance can be detected. Use of this circuit behavior is made by insulating the lever under test from the apparatus and connecting it then to a sensitive bridge circuit similar to that used to measure the resistance change due to strain (the force applied to the lever). This gives us an accurate timing mark for the beginning and ending of the cycle.

In order to add more information to the timing curve (Fig. 3 bottom) it was decided that the moments the bell crank started and finished moving should be determined. This information was found by grounding the bell crank and insulating the adjustable stops. The stops could then be used as switches. By connecting the stops in parallel and then wiring them in series with a resistor connected in the bridge which determines contact with the lever, we get the information shown in Figure 3 bottom. This information allowed a detailed analysis of Apply Pressure to be made.

The relationship between the grounded bell crank and the insulated stops during all parts of the Apply Pressure cycle can be shown diagrammatically. All the while the subject is building up tension in his arm, from t_1 to t_2 in Fig. 3, the bell crank is resting on Stop A. (Fig. 4)

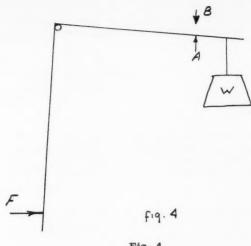


Fig. 4

When sufficient force has been applied to the bell crank to overcome the resistance of it, both the lever to which the force is being applied and the bell crank begin to move. This move ends when the bell crank reaches Stop B, i.e., in the time interval from t₂ to t₃ in Fig. 3, the bell crank is moving from Stop A to Stop B. (Fig. 5)

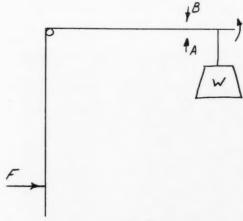
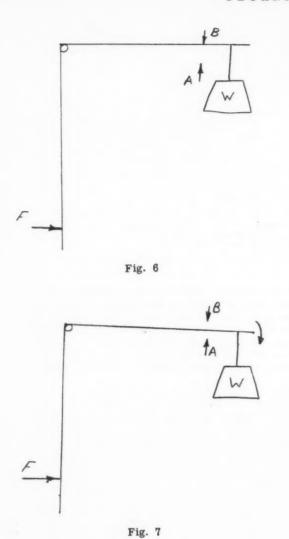


Fig. 5

For physiological reasons the subject holds the lever against the panel a certain length of time, from t₃ to t₄ in Fig. 3. During this interval the bell crank is held against Stop B (Fig. 6)

When the force in the subject's arm has been reduced to a level which is less than the resistance holding the lever, then the lever and the bell crank move back to their initial positions.



After the lever and the bell crank have returned to their initial positions, it takes additional time, from \mathbf{t}_5 to \mathbf{t}_6 in Fig. 3, is required by the subject to remove his hand from the lever. During this period the bell crank rests against Stop A. (Fig. 8)

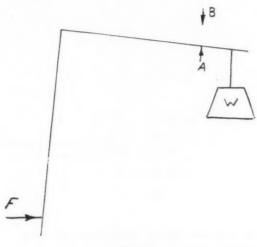


Fig. 8

With the electronic equipment described here, we have been able to disect an element about which little is known. One of the tasks remaining is to analyze and digest the data we have gathered in an attempt to answer the question what affects the time it takes to do an Apply Pressure?

In this interval, from t4 to t5 in Fig. 3, the bell crank is moving from Stop B to Stop A. (Fig. 7)

APPLICATION I

GUIDE FOR SAFE LOCATION OF TWO-HAND TRIP BUTTONS ON POSITIVE TYPE CLUTCH PUNCH PRESSES

by

N. E. Walker, Headquarters Industrial Engineering, Canadian Westinghouse Company Limited, Hamilton, Ontario, Canada

Over the past number of years industry has become increasingly aware of the expense created by accidents, not only the cost of compensation and hospitalization, but also of lost production, employees unrest, and in some cases permanent disabilities. It was this awareness that started safety programs, and in many industries today full time safety staffs are employed.

In Canadian Westinghouse the safety program has reduced the accident rate per million man hours, from 11.7 in 1952 to 9.3 in 1957. A reduction of 20% in the last 5 years.

It has been through the efforts of similar safety staffs, in addition to accident prevention and safety organizations, that the industrial accident rate has been reduced and is still on the downward trend today.

Punch presses for many years, have been among the worst offenders in the number of accidents

worst offenders in the number of accidents

Fig. 1

causing injury to, or loss of, arms, hands, and particularly fingers. This high accident rate has led to the development of such safety features as; sweep, pull-out, and electronic guards, as well as two-hand tripping devices.

The two-hand trip was found to be hazardous, in that, an operator could injure himself by reaching into the press while the ram was on the down stroke. It was noted that presses equipped with friction clutches required constant pressure on the trips during the downstroke, otherwise the machine would stop automatically. This, therefore, would not be a safety hazard. However, presses equipped with positive type mechanical clutches could be injurious, as this press will complete the stroke once the cycle has started, even if trips are released.

Our department was thus presented with the problem of determining a safe distance at which to locate the two-hand trips on mechanical-clutch presses. Fig. 1 and Fig. 2 show two common types of machine mounted two-hand trips.

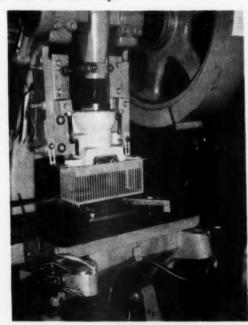


Fig. 2

APPLICATION I

The first variables noted were, stroke speed (or strokes per minute) and stroke length. Delving deeper, it was found that some machines had an instantaneous trip while others experienced a time delay waiting for the clutch position to revolve for engagement, called "clutch lag." Further investigation highlighted the point that when the punch was 1/4 inch above the die no damage could be done to a body member. All these factors could be calculated, and the results produced in time. As the end result required was a safe recommended distance, at which to locate the trip buttons, it was necessary to find a way to change time into distance. For this purpose, it was essential to use a predetermined time system and Methods Time Measurement was chosen, as it is internationally used, and is one of the time measurement techniques in use at Canadian Westinghouse.

MTM, which is an abbreviation for Methods
Time Measurement, is a procedure that analyses
a manual operation or method into the basic motion required to perform it, and assigns to each
motion a predetermined time standard, which is
determined by the nature of the motion and the
conditions under which it is made. It is based
on the following facts:

- Any manual operation is made up of distinct and recognizable basic motions.
- Each basic motion has a constant time value at the average performance level.
- Research has measured the time values for all basic motions. These time values are published on what is known as the MTM data card.

As indicated, the MTM data are measured time values for all basic motions. A variety of operations were photographed. At the same time, all the conditions surrounding the operation were recorded. Each operator was rated by an accepted leveling procedure. Detailed analysis of the resulting films yielded time values for each basic motion. These have been substantiated by frequent checks against time study data and also through research by Cornell University.

The unit of time as shown on the MTM data card is a Time Measurement Unit, abbreviated to TMU. The data card or tables therefore, show the number of TMU's required by an operator of average skill, working with average effort, to make the motions under average conditions.

To change TMU into time units, the following conversion factors must be applied:

1 TMU = .00001 Hours

1 TMU = .0006 Minutes

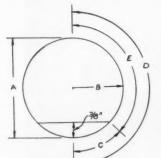
1 TMU = .036 Seconds

The foregoing has provided some history and familiarization with the factors involved. The remainder of this article will deal with the steps taken, and mathematics used, to compile the final application sheet. Wherever an explanation is required, it will be noted prior to the computations so that the method of compilation will be explained in its correct sequence.

STEP #1 - Time required per stroke, at various stroke lengths, and Machine Speeds

The first basic step was to determine the amount of time contained in the down stroke of the press that an operator could injure his hands. Recognition of the fact that on the average, the punch entered the die by 1/8 inch, and that it would be impossible for an operator to get his fingers into the die in the 1/4 inch of stroke prior to the punch entering the die, resulted in the equation: Down stroke - 3/8" = Portion of stroke that could be considered dangerous.

The next problem in this basic step was to determine the percentage of down stroke when injury could be caused. This is complicated by the action of the press, as the ram is actuated by an eccentric driver. The problem then became the percentage of the arc required to move the ram all but 3/8 inches. The following diagram will serve to clarify the problem. The circle represents the travel of the eccentric in one complete stroke.



LEGEND

- A. Stroke length
- B. Eccentric radius
- C. Arc of down stroke considered safe
- D. Down stroke
- E. Arc of down stroke possible dangerous

All that is left at this point is to complete the calculations necessary for the various strokes of the presses in our press department. This was compiled in table form for ease of calculation and reference.

Z x 100 2.24 .90 3.14 71.3 1.5 1.09 4.72 3.63 76.9 2.0 1.24 6.23 4.99 80.1 5 1.39 7.86 6.47 82.3 6 3.0 1,52 7.90 83.9 3.5 1.63 10.98 9.35 85.2 8 4.0 1.76 12.57 10.81 86.0 9 1.85 14.12 12,27 86.9 10 5.0 1.95 15.70 13.75 87.6 11 2.04 17,28 15.24 88.2 12 6.0 2.13 18.85 16.72 88.7 13 2,21 20.45 18.24 89.2 14 2.31 7.0 22,00 19.69 89.5 2,40 21.15 15 23.55

Having determined the percent of stroke considered to have the possibility of injury, it is necessary to apply this to the time required for the machine to complete the down stroke. This is done by calculating the time per stroke in decimal hours and dividing by two (2).

As all time calculations will eventually be converted to distance through the use of MTM, they have been calculated in TMU's (time measurement units).

Strokes/Hin	Dec bra/stroke	Down stroke in T.M.U's
50	.000333	16.7
60	.000278	13.9
70	.000238	11.9
80	.000208	10.4
90	.000185	9-3
100	.000167	8.4
110	.000153	7.7
120	.000139	7.0
130	.000128	6.4
140	.000119	6.0
150	.000111	5.6

To complete the first basic step, it is now necessary to multiply the percentage found in the first calculation by the time from the second. As the per cent varies with stroke length, and the time varies with the strokes per minute, it was required to construct Table A.

TABLE A
TIME IN T.M.U. THAT STRONE COULD CAUSE INJUST

Stroke length	-				# UMBE	er of	STROKE	IS PER	HINUTE		
	50	60	70	80	90	100	110	120	130	140	150
2	11.9	9.9	8.5	7.4	6.6	6.0	5.5	5.0	4.5	4.3	4.0
3	12.9	10.7	9.2	8.0	7.2	6.5	5.9	5.4	4.9	4.6	4.3
4	13.4	11.1	9.5	8.3	7.4	6.7	6.2	5.6	5.1	4.8	4.5
5	13.7	11.4	9.8	8.5	7.6	6.9	6.3	5.7	5,2	4.9	4.6
6	14.0	11.7	10.0	8.7	7.8	7.1	6.5	5.8	5.4	5.0	4.7
7	14.2	11.8	10.1	8.8	7.9	7.2	6.6	6.0	5.4	5.1	4.8
8	14.4	12.0	10.2	8.9	8.0	7.2	6.6	6.0	5.5	5.2	4.8
9	14.5	12,1	10,4	9.0	8.1	7.3	6.7	6.1	5.6	5.2	4.9
10	14.6	12,2	10.5	9.1	8,2	7.4	6.8	6.1	5.6	5.3	4.9
11	14.7	12.3	10.5	9.2	8.2	7.4	6.8	6.2	5.6	5.3	4.9
12	14.8	12.3	10.6	9.2	8.3	7.5	6.8	6.2	5.7	5.3	5.0
13	14.9	12.4	10.6	9.3	8.3	7.5	6.9	6.3	5.7	5.4	5.0
14	15.0	12.4	10.7	9.3	8.3	7.5	6.9	6.3	5.7	5.4	5.0
15	15.0	12.5	10.7	9.3	8.4	7.6	6.9	6.3	5.8	5.4	5.0

STEP #2 - Time Consumed by Clutch Lag on Various Clutches and Machine Speeds

The second basic step was to determine the affect of the delay created when the clutch does not engage instantaneously, which for our purpose has been termed "clutch lag." It was found that four conditions could exist:

- 1. Instantaneous

 Where the clutch engages instantly. As there is no time lag in this condition, allowances for it will not be required.
- 2. 2 Position Clutch

 Clutch engages in any one of two positions. This means that the flywheel could revolve 180° before engaging. The revolution of 180° is the maximum or worst possible condition and therefore is used as the basis for calculation. The same criterion is used in the remaining clutch conditions.
- 3. 3 Position Clutch Clutch engages in any one of three positions. This has a maximum revolution of 120° before engaging.

4. 4 Position Clutch Clutch engages in any one of four positions. This has a maximum revolution of 90° before engaging.

The time delay created by the clutch lag was calculated by dividing the machine stroke time by 2 (as in the case of a 2 Position Clutch), 3 and 4. The following times are the results of this calculation. Again, all times are shown in TMU (Time Measurement Units).

Strokes/win	Stroke time	2 Position) Position	4 Position
50	33.3	16.7	11.1	8.3
60	27.8	13.9	9.3	7.0
70	23.8	11.9	7.9	6.0
80	20.8	10.4	6.9	5.2
90	18.5	9.3	6.2	4.6
100	16.7	8.4	5.6	4.2
110	15.3	7.7	5.1	3.8
120	13.9	7.0	4.6	3.5
130	12.8	6.4	4.3	3.2
140	11.9	6.0	4.0	3.0
150	11.1	5.6	3.7	2.8

STEP #3 - Distance of Reach for Corresponding Time, under Various Stroke Lengths and Speeds with Variable Clutches

The third step is to convert the times, found in steps one and two, into distance. As this is done through the use of MTM, a more detailed explanation of the basic motion reach is warranted.

Reach can be defined as being the basic motion employed when the predominate purpose is to move the hand to a destination or general location. There are three variables which affect reach.

- 1. Distance reached in inches.
- 2. Condition, or nature of object, toward which the reach is made.
- 3. The continuity of motion whether or not the hand is in motion at the beginning and/or the end of the reach.

Distance reached is a variable that is apparent and self explanatory, for it can be readily seen that to reach 20 inches would consume more time than to reach 2 inches under the same conditions.

Condition of Motion has been broken down into five cases:

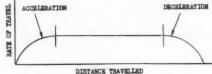
- Case A When reaching to an object in a fixed location, or to an object in the other hand, or on which the other hand rests.
- Case B When reaching to a single object in a location which may vary slightly from cycle to cycle.
- Case C When reaching to an object jumbled with other objects in a group, so that search and select occur.
- Case D When reaching to a very small object, or where an accurate grasp is required.
- Case E When reaching to an indefinite location to get hand in position for body balance, or for the next motion or out of the way.

Continuity of Motion has been broken down into three types:

- Type I When the hand is not moving at the beginning or end of the reach.
- Type II When the hand is in motion at either the beginning or end of the reach.
- Type III When the hand is in motion at both the beginning and end of the reach.

These can be best illustrated by the following diagrams:









APPLICATION I

The reach an operator would use when reaching into the die from the trip would likely be made to a slug, piece, or to the die or punch. In all these cases, the reach would be to a single object whose location may vary slightly. This is a Case B reach. The type of motion would be Type I, where both acceleration and deceleration would be required. Distance reached is the other variable, which in this case is unknown, but we do know the time required. Hence, it is possible to find the distance from the data card by fitting the time, type of motion, and case of reach, into the table.

Up to this point there has been no consideration given to the use of an allowance for a safety factor. To arrive at a conclusion all possible contributing phases must be reviewed.

- It is a recognized fact that the average operator cannot increase efficiency by any more than approximately 20% in speed of movement alone.
- The greater the distance, the greater the possibility of body movements to assist in accomplishing a reach.
- Some of the dual trips on an air clutch have a minor delay between tripping of the press and clutch engagement. This is probably caused by the pressure building up in the line to a sufficient strength to actuate the clutch.

After careful consideration, it was decided, that by doubling the distance an operator could reach at the average performance level (data card distance - time relation) would allow a sufficient safety factor.

The possibility of combined motions in the greater distances, resulted in the limiting of the reach distance to 36", and recommending that if any reach in excess of 36" is required for the desired safety, the pedestal type trip should be used, or other safety devices incorporated.

In converting the time values already calculated to distance, it was found necessary to interpolate the reach table as shown on the data card. This was done for Reach, Class B, Type I motion, and for Reach, Class B, Type III motion, noted as R-B and m R-B m respectively.

The reason for both types being shown is to enable the compilation of a simple table for application. The actual reach performed by an operator in all cases would be an R-B reach.

As the final tables vary with length of stroke, strokes per minute, and the additional factor of clutch lag when required, the basis for table I has been calculated on a R-B motion, with the added clutch lag, table 2, as an m R-B m motion. The acceleration and deceleration having been allowed for in table I.

Distance	R-B Time	n R-B m Time in TMU's	Distance	R-B Time in TMU's	m R-B m Time
5	7.8	2.2	21	19.4	13.8
6	8.6	2.8	22	20.1	14.5
7	9.3	3.7	23	20.8	15.4
8	10.1	4.3	24	21.5	16.1
9	10.8	5.0	25	22.2	16.8
10	11.5	5.7	26	22.9	17.5
11	12.2	6.4	27	23.7	18.3
12	12.9	7-3	28	24.4	19.0
13	13.7	7.9	29	25.1	19.9
14	14.4	8.6	30	25.8	20.6
15	15.1	9-3	31	26.5	21.3
16	15.8	10.0	32	27.2	22.0
17	16.5	10.9	33	28.0	22.8
18	17.2	11.6	34	28.7	23.5
19	17.9	12.3	35	29.4	24.2
20	18.6	13.0	36	30.1	24.9

The final table expression is a result of converting the time values found in step 2 into distance through the use of the foregoing reach interpolations and appears as outlined in the final result, which is the application sheet.

APPLICATION I

APPLICATION SHEET

GUIDE FOR SAFE LOCATION OF TWO-HAND TRIP BUTTONS ON

POSITIVE TYPE CLUTCH, PUNCH PRESSES

The distance shown in the following tables have been calculated working from the nearest edge of the punch and die, but should be applied to the closest point of danger.

All distances shown have been calculated to allow 200% of the average performance level.

NOTE: Where the total distance shown is greater than 36" other safety devices should be used.

Case A Positive clutch with no clutch lag use table 1

Case B Positive clutch with clutch lag - use table 1 plus table 2

TABLE #1

STROKE				Number	of	Strokes	Per	Min.			
ALLES TO A STATE OF THE STATE O	50	60	70	80	90	100	110	120	130	140	150
2"	27	22	18	15	12	11	9	8	7	6	5
3"	30	24	20	16	14	12	10	9	8	7	5
4"	31	25	21	17	15	13	11	10	8	7	7
	32	26	21	18	15	13	12	10	8	8	7
5"	33	27	22	18	16	14	12	10	9	8	7
7"	34	27	22	19	16	14	12	11	9	8	7
8 ^m	34	27	22	19	16	14	12	11	10	8	7
9"	34	28	23	19	17	14	13	11	10	8	8
10"	35	28	23	19	17	15	13	11	10	9	8
11"	35	28	23	20	17	15	13	11	10	9	8
12"	35	28	24	20	17	15	13	11	10	9	8
13"	36	29	24	20	17		13	12	10	9	8
14"	36	29	24	20	17	15	13	12	10	9	8
15"	36	29	24	20	17		13	12	10	9	8 8 8 8 8

TABLE #2

No. of	Max	Number of Strokes Per Min.										
Positions	Rotation	50	60	70	80	90	100	110	120	130	140	150
2	180°	-	-	34	30	27	25	23	21	20	19	17
3	120°	32	27	24	21	19	25 17	23 16	15	14	13	12
4	90°	25	21	19	16	15	14	13	12	11	10	10

APPLICATION II

With the emphasis that exists on Material Handling in Industry today, the "Journal" presents an interesting Time Formula of Banding Pallett Loads.

OPERATING TIME FORMULA REPORT

by

O. D. Scarborough U. S. Naval Ammunition Depot Crane, Indiana

> Formula No. 1 Date: 4/19/57

PART:

Band with steel strapping wood or steel containers to a 40" x 48" steel or wood pallet.

OPERATION:

Band pallet of containers.

MATERIAL:

Steel banding 1/2" to 3/4" wide.

WORK STATION:

Any packing or shipping area.

ALLOWED TIME:

- Loads 10 inches to 45 inches in height

 .00210 + X(.01361 + Table I)

 Where X = number of bands per pallet load.
- b. Loads 45 inches to 65 inches in height

 .00210 + X(.01448 + Table 1)

 Where X = number of bands per pallet load.

APPLICATION:

This formula applies to the banding of containers with two to eight 1/2" to 3/4" steel bands with one metal seal per band, by the method in use at the present time. The length of banding, from 120" to 210" in length, varies with the height of the load on the pallet. The bands will run through the pallet parallel to the pallet stringers.

ANALYSIS:

This operation is manual. It is performed by one operator. The operator will band pallets in other areas or may perform other work such as load pallets, package material or stencil boxes when not fully occupied by banding operations. The other operations are not covered by this formula.

Tools used consist of one hand operated banding stretcher, one seal crimper, one signode model DF-10 banding dispenser mounted on wheels and fitted with a spool of 1/2" or 3/4" banding. The size of the pallet is 40" x 48" and is made of either steel or wood. The pallet rests on the floor always in the same general area. The bands must always encircle the load passing through the pallet. Two to eight bands are used per pallet. All bands are parallel to one another and to the pallet stringers.

The operator will be furnished written operator instruction and sketch showing the number of bands, size and location of banding on pallet.

A 15% allowance is included in the allowed time.

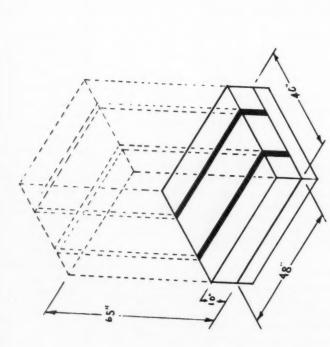
PROCEDURE:

As soon as the pallet is loaded the operator reaches for the steel banding and grasps it and shoves it through the pallet. When the correct amount of banding has been threaded through the pallet the operator walks to the opposite side of the pallet. He stoops and grasps the banding with right or left hand (owing to the side of the pallet being banded) and returns to the opposite side of pallet with the end of banding, laying the band on top of load. He then grasps the loop end of the banding at the banding dispenser and moves the loop to join the cut end of banding. The operator gets the band stretcher and positions it on the banding. He takes up the slack by operating the stretcher. Next he places a seal on the banding and completes tightening the strap. He gets the crimper and crimps the seal. Then he removes the stretcher and breaks the banding by bending it back and forth at the seal. He then returns stretcher and crimper to the top of the load or to band dispenser.

TABLE I

THREAD BAND THROUGH PALLET FROM HEIGHT 10" to 66"

8	.0209	.0396	.0584	.0771	6960°	1146	1330	1521
2	.0208	.0395	.0583	0770	.0957	1144	1388	1519
62	.0208	9660	0582	6920°	9260	.1142	1329	.1516
9	.0208	.0394	.0581	1940.	0954	1141	1327	1514
8	.0207	.0394	0960	9920	.0953	1139	.1328	1511
28	.0207	.0393	6250	0.0765	1960	.1137	1323	1509
3	.0207	.0392	8750	.0764	0960	.1136	.1321	.1507
25	.0206	.0392	.0577	.0763	9760	.1133	.1319	1504
20	.0206	.0391	92500	.0761	.0947	1132	.1317	.1502
28	•0206	.0390	.0575	09/0°	.0945	1129	1314	.1499 .
9	•0200	0330	•0574	°0758	*0943	.1127	11811	.1495
\$	9610°	.0371	.0547	°,0722	.0897	.1072	.1247	.1423
5	9610*	.0371	.0545	.0720	£680°	02010	.1245	.1419
9	.0195	.0370	.0544	•0719	• 0893	.1067	.1242	,1416
8	°010°	.0369	.0543	.0717	1680*	.1065	.1239	.1413
8	.0195	9980°	°0542	•0715	6880°	.1062	.1236	•1409
*	.0194	•0367	.0540	.0713	.0887	.1060	.1233	.1406
8	.0194	0367	°0539	.0711	.0884	.1057	.1229	.1402
30	.0193	9960°	.0538	0170°	.0882	.1054	1226	.1399
8	.0193	.0365	°0536	•0708	0880	.1052	.1224	°1395
8	•0193	0365	.0635	,0707	9780°	•1049	1221	°1392
র	•0192	*0364	.0534	0,0705	9280°	.1047	.1218	•1389
8	•0192	.0362	•0533	.0703	.0874	.1045	.1215	1386
8	*0191	0361	.0532	.0702	°0872	.1042	,1212	.1383
18	1610*	0960°	.0530	.0700	°0870	0010	.1209	•1379
16	00100	.0329	•0528	,0697	°0867	.1036	.1206	.1374
4	0610°	•0328	.0527	\$690°	*0864	.1032	1201	.1369
12	.0189	.0357	.0525	.0693	.0861	.1028	*11%	.1364
10	.0188	•0326	.0523	0690*	°0828	.1024	.1192	•1359
No. of Bands	-	64	m	4	in.	0	7	80









STRAP DISPENSER

BANDING

ING OPERATION

APPLICATION II

TABLE OF ELEMENTS

		TMUs	Conversion factor .COCC1 leveled time	Allow- ance	Allowed Time
A	Stretcher, crimper, get and place on load	51.6	.000516	15%	.00059
В	Seals, get several and place on load	92.3	.000923	15%	.00106
С	Thread banding through pallet a. 10" High Table I b. 20" High Table I c. 30" High Table I d. 40" High Table I	270.9 296.6 313.7 333.0	.00 2709 .00 29 66 .00 31 37 .00 33 3	15% 15% 15% 15%	.00312 .00341 .00361 .00383
	e. 50* High Table I	350.7	.003507	15%	.00403
D	Walk to opposite end of pallet	92.5	.000925	15%	.00106
E	Return to original end of pallet with band	91.9	.000919	15%	.00106
F	Band and loop together	79.7	.000797	15%	.00092
G	Stretcher, get, place under band (load height under 45")	84.8	.000848	15%	.00098
Н	Stretcher, get, place under band (load height over 45")	107.4	.001074	15%	.00124
J	Tighten banding to remove slack and add seal (load height under 45")	149.0	.00149	15%	.00171
L	Tighten banding to remove slack get seal and add to band (load height 45" and over)	202.0	.00202	15%	.00232
M	Band, complete tightening	57.1	.000571	15%	.00066
N	Crimper, get crimper and crimp seal	117.1	.001171	15%	.00139
P	Crimper, remove and aside	31.5	.000315	15%	.00036
Q	Stretcher, band, remove	81.2	.000812	15%	.0009
R	Banding, break, bend end and aside	120.8	.001208	15%	.00139
T	Banding dispenser, relocate	228.8	.002288	15%	.0026
U	Walk, to pallet for next band	48.6	.000486	15%	.0005
V		38.7	.000387	15%	.0004

SPER	OPERATION Band Pallet		4	ANALYST	ODS	SHEET NO. 8	1	OF 24 SHEETS	OPERATIO	OPERATION Band Pallet			ANALYST ODS	T 000	SHEET NO. 9	OFZW	SHEETS
1			1	NAME OF PERSONS				-	-		-	-	- Constitution	100			
Ŋ.	AMAI CH CH REMENT DESCRIPTION RE	ANALYBIS EL CHARY REF.	ELEMENT TIME TMU	CONVERSION PACTOR LEVELED TIME	MALLOWANCE	ELEMENT TIME ALLOWED	OCCURRENCES PER PRECE OR CYCLE	TOTAL TIME ALLOWED	. 990	ELEMENT DESCRIPTION	AMALYBIS CHART REF.	ELEMENT TAME TMU	PACTOR PACTOR LEVELED TIME	ALLOWANCE	TIME TIME ALLOWED	OCCURRINGES PER PECE ON CVCLE	TOTAL TIME ALLOWED
B	Band stretcher and crimper, get		51.6	915000.	158	65000	1	A 65000	V. Remo	Remove crimper and band stretcher	2	38.7	786000.	851 158	570000	-	2,000.
	and place on load	-				The state of the s			to b	to band dispenser after last.							
B	Seals, get several seals and place	6	92.3	.000923	15%	90100	1	90100	banding	13ng							
0	on load	-						-									
Ca. T	Thread banding through pallet (10"	27	270.9	.002709	15%	.003115	1	.00312									
D	high)	-															
CD.	Thread banding through pallet (20"	50	9.962	996200.	15%	14600.	1	1,000.									
Ce.	Thread banding through pallst (30"	31	313.7	.003137	15%	,003607	7	.00361									
4	high)																
Cd. Th	Thread banding through pallet (40° high)	33	333.0	.00333	15%	.003829	1	.00383									
Ce. Th	Thread banding through pallet (50"	350	350.7	.003507	15%	.00/0033	1	.00003									
h	high)																
3	Walk to opposite end of pallet	6	92.5	526000.	158	90100	1	,00106									
4	and get band																
æ	Meturn to original end of pallet	91	91.9	.000919	15%	90100	1	90100.									
M	w/band	-	-														
M	End of band and loop together	75	7.67	767000.	158	,00092	1	26000									
St	Stretcher, band, get and place	87	84.8	8/18000	158	86000	-	86000									
5	under band (Load height under 45")																
St	Stretcher, band, get and place	107.4	-	470100.	15%	,00124	1	,0012h									
un	under band (Load height 45* & over)	+															
13	Tighten banding to remove slack	149.0	+	6/1100	158	17100.	-	12100						-			
a	and add seal (Load height under 45")	-															
T	Tighten banding to remove slack	202.0	-	.00200	15%	.00232	1	.00232									
2	and get and add seal (Load height																
15	US" and over)																
Ba	Band, complete tightening	57	57.1	.000571	158	99000.	1	99000*									
8	Get crimper and ordang seal on band	117.1		71100	158	,00135	1	.00135									
Cr	Crimper remove and aside	31.5		.000315	158	96000.	1	960000									
Res	Remove band stretcher	81.2		.000612	151	.00093	1	.00093									
Baz	Banding break, bend end and aside	120.8		.001208	158	.00139	1	.00139									
Bar	Banding dispenser relocate for mext	228.8	-	.002288	15%	.00263	-	.00263									
band	band Walk to pallet for next banding	9.84	-	.0001/86	158	95000.	-	95000.									

OPERATION Band Pall	OPERATION Band Pallet			4	ANALYST	ODS	SHEET NO. 10	OF 24 SHEETS	EETS	OPERAT	OPERATION Band Pallet			ANALYST CES	ANALYST CIG	SHEET NO. 11	OF 24 SHEETS	SHEE
DESCRIP	DESCRIPTION - LEFT HAND	6	LR	THU	2	No.	DESCRIPTION - RIGHT HAND	RIGHT HAND		0	DESCRIPTION LEFT HAND NO.	L. E. H.	THU	×	No.	DESCRIPTION - RIGHT MAND	- RIGHT HA	QMD
A Band stre	Band stretcher and crimper,									C-8. 1	Thread banding through pallet (10" high)	(10" hi	(tha					
get and p	get and place on load			T		+							8	0	E	for houndlene		
				38.6	TRC1	-	Turn to stretcher and crimner	and crimp	er.		Reach to banding	R26B	240	1	B	Reach to banding		
Reach to crimper	crimper	9	RZOB		Raed		Reach to crimper			0	Grasp banding) a	2.0	OIA.	Q	Greep banding		
Grasp crimper	nper		910	2.0	GIA	9	Grasp			×	Move and of banding to	ABB.	92.4	M28B	h Mor	Nowe handing through pallet	Dugh pall	at
				29.0	œ	90	Bend				pallet							
					GA	[4	Turn body			æ	Release banding	LIB.	8.0	RLI	la Re	Release banding		İ
Hove crim	Move crimper to load	9	H168		997EN	I	Move stretcher to load	load)	97.6	RZÉB	1 Be	Reach to banding		
		,	1	2.0	HE	-	Belease stretcher			0	Guide banding w/LH		8.0	A10	Il Om	Grasp banding		
				51.6									2.0	PL3	- See	Release banding		
													31.9	SV	Arise			
Seals, ge	B Seals, get several seals and													STATE OF THE PERSON NAMED IN	Walk	K		
place on load	load												270.9					
				21.2	R22C	B	Reach to seals			C-b. Th	Thread banding through pallet (20° high	(20° hig	-					
					K										-			
The state of the s	The second state of the se			9.1	OUB	9	Grasp seal					(29.0	03	To	To banding		
All the first of t				11.2	0.5	2	Regrasp seal			Re	Reach to banding	(R26B)		Book a	2	Reach to banding		
+				9.1	GAB	0	Grasp second seal			Gr	Grasp banding) _a	2.0	ALD.	Ora	Grasp banding		
				11.2	05	2 8	Segrasp seal			Mo	Move end of banding to pallet	HBB	92.4	M 28B	4 Mo	Hove banding through pallet	ough pall	at
				9.1	GLB	9	Grasp other seal			8	Release banding	RL1	8.0	RL1	4 Re	Release banding		
					M22B	K	Move seal to load)	97.6	R26B	A Res	Reach to banding		
					TROP	4	Turn body						8.0	ALD	le Orn	Grasp banding	4.00	
				2.0	RLI	GF.	Balease			S	Guide banding w/LH		11.5	RIOB	B	Reach to handing	and the state of t	-
				92.3									2.0	VID.	Gra	Grasp banding		
													12.2	MOOR	Mox	Move handing		
													2.0	REI	Re	Release banding		
				1		-							31.9	2	Arise	3.0		
				1		+							7 700	2	N N N N N N N N N N N N N N N N N N N			
-			BILEM		CONVERSION	+			1	-		-		CONVERSION	L		SCCUR RESCES	5
ġ	ELEMENT DESCRIPTION		THE		OCCOL	ALLOWANCE	TIME	PER OF ALL	TIME	Ho.	ELEMENT DESCRIPTION		TWU	LEVELED TIME	ALLOWANCE.	TIME	rece on creas	ALLOWE.
Band stru	Band stretcher and crimper, get and	et and	51.6	-	915000.	15%	65000.	0.	000059	-a. Three	C-a. Thread banding through pallet (10* high) 270.9	O. high)	270.9	.002709		,003115	-	.00312
place on load	load		-	1				+	9	-b. Threi	C-b. Thread banding through pallet (20" high) 296.6	O* high)	9997	996200	158	1,003	-	1,600
Seals, ge	Seals, get several seals and place	place	92.3	-	.000923	158	90100"	1	90100									

	Description — вісит нано To banding Reach to banding Move banding Reach to banding Grasp banding Grasp banding Grasp banding Reach to banding Grasp banding Reach to banding Arise Move banding through pallet	C-e. Thread banding through pallet 50" high Beach to banding. Grasp banding. Grasp banding to pallet 60 GlA Goulde banding w/lH Goulde banding w/lH	50" high	29.0 2.0 2.0 115.5 10.0 122.0 10.0	z «	No. DESC	DESCRIPTION - RIGHT NAND	HIGHT HAND
29.0 S 2.0 G14 92.4 M288 4 10.0 88.1 4 10.0 G14 4 18.6 R208 2.0 G14 4 18.2 R208 2.0 G14 4 18.5 R208 2.0 G14 4 115.5 R208 2.0 G14 4 115.5 R208 2.0 G14 4 115.5 R208 2.0 G14 5 110.0 R11 5 112.0 R208 5 G14 5 112.0 R208 5 G14 6	ndir	Guide banding w/LH	RESERVATION OLA STATE OLA	29.0 2.0 115.5 10.0 122.0 10.0			RIPTION - RIGHT	NAME
29.0 S 29.0 S 2.0 G1M 32.0 G1M 32.0 G1M 19.0 R11 I 19.0 G1M 118.5 R288 2.0 G1M 118.5 R288 2.0 G1M 118.5 R288 2.0 G1M 118.5 R288 2.0 G1M 118.5 R288 5 110.0 R11 5 112.0 R288 5 1	banding ch to banding ap banding through pallet asas banding through pallet oh to handing sp banding ap banding ap banding the banding	Grap banding through pallet Baach to banding Grap banding More and of banding to pallet Coulde banding w/LH	(RESB) OLA MESB	29.0 2.0 115.5 10.0 10.0 10.0	S			
29.0 S	ch to banding ap banding ab banding through pallet ease banding by banding py banding sp banding sp banding sp banding through pallet ease banding through pallet t	Beach to banding. Greep banding Move end of banding to pellet. Guide banding w/LH	1 (E)		S			
2.0 01A 1288 1, 10.0 87.1 8.2 8.2 8.2 8.2 8.2 8.2 8.2 8.2 8.2 8.2	cch to banding ap banding a banding through pallet ease banding th to banding th to banding th to banding ap banding ase banding through pallet to the banding through pallet the banding through pallet the banding through	Reach to banding Gree banding to pallet. Guide banding w/LH	N CENTROLL OF THE SECTION OF THE SEC		1	To banding		
2.0 014 92.1, N288 1, 10.0 81.1 10.0 10.0 10.0 10.0 10.0 10.0	ap banding a banding the banding by banding py banding py banding py banding asse banding the banding the banding the banding base banding the	Orange banding to pallet. Outde banding w/IH			P 28pg	Beach to handing	andina	
92.1, N.288 1, 10.0, R.11 1, 10.0, G.14 1, 10.0, R.11 5 1, 10.0, R.11 5 1, 10.0, G.14	a promoting a promoting construction and to handing a panding	Guide banding w/lH						
92-1, M288 1, 10.0 88.1 1, 10.0 92.4 1, 10.0	e barding through pallet asse banding to to banding sp banding to to banding through pallet asse banding se k	More end of banding to pallet. Quide banding w/LH			1	+	Sur Sur	
10.0 REJ 4 97.6 R268 14 10.0 GUA 14 10.2 R268 2.0 GUA 10.2 R21 10.3 R2 10.0 GUA 10.5 R288 5 1 10.0 R21 5 1 10.0 R21 5 1 10.0 GUA 5 1	ease banding th to banding th to banding th to banding ap banding banding through pallet sase banding k	Ouide banding w/LH			M28B	5 Move bandi	Mowe banding through pallet	11et
97.6 8286 1, 16.6 87.0 61.4 1, 18.2 8286 2.0 01.4 13.9 4.5 13.9 4.5 13.9 4.5 13.9 6.5 13.9 6.5 13.9 6.5 13.0 0.0 87.1 5 1.22.0 R28 5 1.	oh to handing sp banding p banding p banding e banding through pallet same banding ke	Ouide banding w/LH)		RL1	5 Release banding	ding	
2.0 01A 2.0 01A 2.0 01A 2.0 01A 31.9 AS 313.7 29.0 S 29.0 S 20 01A 115.5 M28B S 110.0 RIL S 112.0 R28B S 112.0 R28B S	sp banding ch to banding sp banding e banding through pallet same banding ke	Ouide banding w/LH			R28B	S Reach to banding	ndine	
2.0 01A 2.0 01A 2.0 RL1 31.2 ASB 2.0 RL1 331.7 ASB 2.0 01A 115.5 ASB 2.0 01A 115.5 ASB 2.0 01A 115.0 RR1 2.0 O1A 115.0 RR1 2.0 O1A 115.0 RR1 2.0 O1A 115.0 RR1 2.0 O1A 115.0 RRB 2.0 O1A 2.0 O1A 2.	ch to banding p banding e banding through pallet asse banding re r						200	
2.0 014 2.0 813 31.9 45 313.7 45 2.0 014 115.5 H28B 5 1 10.0 R11 5 1 10.0 R11 5 1	ap banding p banding through pallet ase banding s f			4		-		
2.0 REL 31.9 AS 313.7 ME 22.0 GIA 22.0 GIA 22.0 GIA 22.0 GIA 22.0 GIA 22.0 REL 22.0 RER 22.0 GIA 22.0 RER 23.0 RER 23.0 RER 24.0 RER 25.0 GIA 25.0 REL 25.0 GIA 25.0	pp Danding - banding through pallet base banding se K			_	KL40	Meach to Danging	parag	
2.0 Rill 31.9 AS 20.0 S 20.0 S 20.0 OA 115.5 M28B 5 1 10.0 Rill 5 122.0 R28B 5 1	e banding through pallet asse banding k			2.0	ALO	Orsep banding	du	
2.0 BELL 31.9 AS 313.7 PAPE 20.0 S 20.0 GAR 115.5 M28B 5 10.0 RIL 5 122.0 R28B 5 10.0 GAR 5 GAR 10.0 G	sase banding			13.h	M12B	Move bandiu	Move banding through pellet	llet
31.9 AS 313.7 22.0 GA 22.0 GA 115.5 M28B 5 112.0 RZ1B 5 112.0 GA 115.0 GA 1	r F Danding			2.0	RL1	Release banding	ding	
29.0 S 20.0 G G M 2 C G G M 2 C G G G M 2 C G G G G M 2 C G G G G M 2 C G G G G G G G G G G G G G G G G G G	k Danding			31.0	48	Arrian		
20.0 3 20.0 3 20.0 01A 115.5 K28B 5 10.0 R11 5 112.0 R28B 5	panding.				1	10.00		
29.0 S 20.0 S 2.0 GIA 115.5 M28B 5 110.0 RIL 5 122.0 R28B 5 10.0 GIA 5	banding					No.		
29.0 S 20.0 S 2.0 G 3.0 S 115.5 H28B 5 112.0 R71 5 112.0 R28B 5 110.0 G 11A 5	banding			7.065				
g to pallet (MEB) 115.5 M28B 5 ELL 10.0 R11 5 122.0 R28B 5 10.0 01A 5		D. Walk to opposite end of pallet and get band	d get ban	p				
g to pallet (MEB 115.5 M28B 5 (EL) 10.0 RIJ 5 12.0 R2B 5 10.0 RIJ 5 10.0 RIJ 5 10.0 RIJ 5 10.0 GIA 5	Reach to banding		-0-					
g to pallet (MGB 115.5 M28B 5 10.0 RIL 5 122.0 R28B 5 10.0 GlA 5	Grass handing			0.09	d'in	Walk to ade	Walk to adon of nallat	
10.0 RIJ 5	More honding thursday nelling	and the second s						
12.0 R13 5	natural unional durantes			no ko	1	TOWARD DANGING	But	
122.0 R28B 5	Belease banding			1	S	Turn body		
10.0 GIA 5	Reach to banding				Boas	Reach to banding	pding	
	Grasp banding	Annual Control of the		3.5	GIB	Grasp banding	30	
U.O. R2B Beach	Beach to banding			92.5				
	Grasp banding							
4.6 M2B Move t	Move banding through pallet			_				
	Release banding							
AS								
1					-			
ELEMENT CONVERSION	and the second		-		CONVERSION	-		
ELEMENT DESCRIPTION THU LOGGOOD ALLOWANCE LUNELED ALLOWANCE	ELEMENT COLUMNISTE TOTAL TIME PER TIME ALLOWED CYCLE ALLOWED	ELEMENT DESCRIPTION WED		O T		ALLOWANCE ALLOWED	T OCCURRENCES	TOTAL
.003137		0-0	" high) 39	-	.003507	15% .000033	-	.ooloo.
153 Con order of the parties (40" night 555.0 .00333 153	50500.	2		-		+		
		Dates	1	200	COKOON.	907000	-	90100
METHODS ENGINEERING COUNCIL		A Charles of the Char	-	-	-			

OPERATION Band Pallet			ANALYST	ANALYST ODS		SHEET NO. 14		OF 24 SHEETS	340	OPERATION Band Pallet			ANALYST ODS	500	SHEET NO.	15 or 24	OF 24 SHEETS
DESCRIPTION - LEFT HAND	No.	LH THU		H HO.		DESCRIPTION - RIGHT HAND	- RIGHT HAN	9		DESCRIPTION - LEFT MAND	1	THU	*	He.	DESCRIPTIO	DESCRIPTION - RIGHT NAND	MD
E. Return to original end of pallet W/band	et w/ba	pu							н.	and place	under band						
										(Load height 45" and over)							
		31.9	9 AS		Arise,	Arise, bend w/banding	Buipu										
			Test	7	From pallet	llet						25.8	R30B	Reach	Reach to stretcher	er	
		0.09			Walk to	Walk to band reel	1					2.0	ALD	Grasp	Grasp stretcher		
				1	Beares							28.0	M30B6	Move	Move stretcher to band	o band	
		0.10	1									16.2		Squee	Squeeze device		
												8.1	M2C6	Move	Move to band		
F. End of band and loop together												25.3	PZSSD	Posit	Position stretcher	J.	
												2.0	RLI	Release	3.0		
		29.0	B 0		Bend to band	band						107.4					
Seach to loop	ROOR	00	TBBT	1	To pallet	at											
Green band	010	-	2.0						3. 1	Tighten banding to remove slack and	pu						
Nove hand to load	A 2hc	,,	9 AB		Aside a	nd side s	tep W/loo	Aside and side step W/loop of band		add seal (Load height under 45")							
Begreen hand	9			1													
Release band		16.8			Regrass	Regress and alien in hand	based of o			Reach to handle	RBA	11.5	RIOB	Reach	Reach to seal grasp seal	asp seal	
)								0	Gresp handle	OJ.	2.0	OJA.	Grasp	Grasp seal		
									124	Handle up 5	M&B	53.0	HIOB	Move	Move seal to band	P	
Stretcher, band, get and place under band	under b	pand								Handle down 5	MBA	48.5	62	Regra	Regrasp seal		
(Load height under 45*)												6.7	H3C	Move	Move seal on band	9	
												25.3	PZSSD	Posit	Position seal over banding	er banding	
Reach to band stretcher	R168	SB 15.8	8									2.0	RLI	Relea	Release seal		
Grasp stretcher	VT0	2.0	0	-								0.641		-			
Move stretcher to band	HIL	N1486 17.7	7					-						1			
Squeeze device	API	16.2	2											+			
Move to band	M2C6	5.8	60									_		+			
Position stretcher	P2S	P2SSD 25.3	3	-										-			
Release stretcher	HL.1	2.0	0	-										+			
		84.8	80														
		ELEMENT	CONVERSION	BION	-		DCCURRENCES	TOTAL	\vdash		-	EL EMENT	2		ELEMENT	OCCURRENCES	
ELEMENT DESCRIPTION		TMU	.00001 LEVELED	DI ALLO	ALLOWANCE.	TIME	PIECE OR CYCLE	TIME	ģ	ELEMENT DESCRIPTION		-	LEVELED TIME	ALLOWANCE	ALLOWED	PHECE OR CYCLA	ALLOWED
Return to original end of pallet w/band	et w/ban	6.19 0	616000.		15%	90100	7	90100	25	Stretcher, band, get & place under band		107.1	470100.	158	,0012k	-	,00124
End of hand and loop together		79.7	767000.	4	151	26000	7	.00092	7	(Load height 45" and over)	1	+					
Stretcher, band, get and place under band	under b	a la	a.laooo	+	350	90000	,	90000	J	Tighten banding to remove slack and	+	149.0	67100	158	12100	-	12100.
(Ch Jarren auffeu prom)		04.0	3	_		2000	7	SPORT	rei .	on sear (road nergin miner 45)				-			

Particle PART Loaded Pallet			DATE 19	19 Apr 1957	STUDY NO.	No.		PART	PART LORded Pallet		-	DATE 19	DATE 19 Apr 1957	STUDY No.	- 3		
1.00 10.1 10.2	OPERATION Band Pallet	-		ANALYST	ODS	SHEET NO.		HEETS	OPER	ATION Band Pallet	Contract of the Contract of th		ANALYST	900	SHEET NO. 1		BHEET
Tights bright \$C mark not high \$1 at 3 at	DESCRIPTION LEFT HAND		-		No.	DESCRIPTIO	N - RIGHT HAND				LH	\Box	M M	Mo.	DESCRIPTION	- RIGHT HAN	Q
Find in big by 25 and order 180		ik and ge	t and ad	d seal		,				et crimper and crimp seal on b	pasc						
Parch to loading California California	(Load height 45" and over)								æ	each to crimper	R186	17.2		Move	orimper town	prd band	
Crimpo bandle Mail S. 10, Mail Mai	Meach to handle	REA			Reac	ch to seal o	n tray		9	rasp crimper	014	2.0					
Handle down	Grasp handle):			Gras	in seal			ä	risper toward banding	(MILING)	22.1	-	Crimp	to band		-
State Stat			30.	-	Seal	to banding			B	agrasp crimper)8	5.6	- 1	Regra	det		
Single No. 5 Miles 15.0 Mi				100	Bear	Asp seal			Æ	osition crimper on sealer	PZSSD	-		Posit	don crimper	on sealer	
Single down S Miles Mi	Handle up			1					T	ake up slack	N3A	6-7		Take	up slack		-
11 11 15 11 11 11 11 11	Handle down			10					8	agreep orieper	05	5.6		Bagra	up orinper		
10 10 10 10 10 10 10 10				-	Seal	on banding			3	lose crimper	H7A20	18.2		Close	crimper		
2.0 2.1	the control of the co		25.	-	Rosi	tion seal o	a banding		oğ.	quese to close	N.	16.2		Squae	ze to close		
Randa down NG65 12.5 Randa crisque Randa down R			2.0	-	Sele	ase seal						117.1					
Rindle down Right 12.5			302.0														
Randle down Fight 12.5 Randle down 12.5 Ran			+							imper remove and aside		_					
Sandle down High 12-5 Rach to crimpar Randle down High 12-5 Rach to crimpar Randle down High 15-2 Rach to crimpar Randle down High 15-2 Rach to crimpar Randle down High 15-2 Rach to crimpar Rach to crimpar Rach to band stratcher Rach to crimpar Rach to			+		-						400	-	-	-	and annual		
15.6 R168 Reach to crimper R11 2.0 R11 Reach to crimper R12 2.0 R12 R13	Change design	7007	T						-	or or tapes		3.8.2		And de	and annual		
15.2 \$16.6	THE PERSON NAMED IN COLUMN	MON							9 6	Transfer of America):	2.0		Pales	as ardaner		
15.2 0.14 Oresp crisper Q. Resch to band stretcher NRB 15.6 R1GB Resch to band cretcher Resch to band stretcher R1B 15.6 R1GB Resch to band cretcher R1B 2.5 C C C C C C C C C	do array	don's		-	-					TOTAL CLAMPS		31 6	-				
12.0 014 Greap cytimper Q. Ramove band stretcher RRB 15.6 R16B Raech to band Raech to band stretcher 014 2.0 01A Girasp hand Greap ha	uado around	· ADM	T	-		o crimba		-									
S2.1 114 117		-	10.0					9		nove hand atretcher							
State Stat			62 3	1	- CLARS	p cramper					(
Colored Colo			2100						Rea	ach to band stretcher	(BBR	15.8		Beach	n to band		
Thumb on latch Location Loc									Or	asp band stretcher	10	2.0	\rightarrow	Grasi	p band		
Note latch Nia 2.5 Squeese daylor Squeese daylor 16.2 API A									Th	umb on latch	92	0.					
Squeeze davice API 16.2 Squeeze davice API 16.2 API A									Mon	re latch	AIA	2.5					
Squeeze device API 16.2 API						The second second second			Re	grasp	05	5.6					
Name									Squ	seeze device	API	16.2					
16.2 APJ Bend banding 16.2 APJ 16.2 APJ Bend banding 16.2 APJ 16.2 APJ Bend banding 16.2 APJ 16.2 APJ Bend banding 16.2 APJ 16.2 A									2	sove stretcher from band	D38	22.9		-			
Sile Comparison Compariso												16.2	APL	Bend	banding		
Complete tightening		_									81.2						
202.0 ,CG202 15% ,CG212 1 ,CG202 1	ELEMENT DESCRIPTION		TOME TAND		% ALLOWANCE				ġ	ELEMENT DESCRIPTION		ELEMENT THE THU	¥	% ALLOWANCE		2	TOTAL
57.1, .000571 15% .00066 1 .00066 0 Memore band streatcher 81.2 .000812 15% .00093 1	Tighten banding to remove slack	and pet.		00000	148	00032		!	1	t crimper and crimp seal on ba	and	117.1	171100.	158	.00135	1	.001
57.3, .000571 156 .00066 1 .00066 Q Besove hand stretcher 61.2 .000612 156 .00093 1	and add seal (Load height 15" a	nd ower)		-		1		1 1	-	imper remove and aside		31.5	.000315	158	96000°	-	000
	Band, complete tightening		57.1	.000571		99000	+		-	move hand stretcher		81.2	,000812	158	.00093	-	5000

PART Loaded Pallet		DAT	DATE 19 Apr 1957	. 1957	STUDY NO.	No.		PAR	PART Loaded Pallet		DA	DATE		ó	
OPERATION Band Pallet		ANA	ANALYST OID	19	SHEET NO. 18		OF 24 SHEETS	OPE	OPERATION Band Pallet		AN	ANALYST	ору вне	SHEET NO. 19 OF	OF 24 SHEETS
DESCRIPTION LEFT HAND NO.	LH	TMU	2 2	No.	DESCRIPTION	1 7	QN QN		DESCRIPTION LEFT HAND NO.	гн	TMU	2 2	No.	DESCRIPTION - RIGHT HAND	I HAND
R. Banding break, bend end and aside								ν.	Remove crimper and band stretcher	ler					
	(-							to band dispenser after last banding	Buiput	1				
Aside band stretcher	11285 10	10.6	/ AP2	To be	To bend banding			-							
Melease band stretcher	X	8.7	HLAS	Bend	Bend banding						12.9	R128	Reach to crimper	crimper	
Aside band	R-E / 36	36.6	HIA	6 Bend b	Bend band and fold to break	ld to bres	ak					Q1V	Grasp		
		-	02	3 Begra	Regrasp band				Move stretcher to dispenser	M 20B6	21.8	TBCI	Turn to dispenser	ispenser	
	16	16.2	APL	Bend	Bend band w/fingers	175	-	-	tray						
	31	31.9	AB	Aside								1300	Move to d	Move to dispenser tray	
	92	8.02								RLI	2.0	RL1	Release		
Banding dispenser relocate for next band	t band										30.7				
	16	18.6	TBC1	Towar	Toward dispenser										
la l	1	-	410												
	8	+	WILL	Mark	Walk to dispenser										
	37	37.2	TBC2	Get 1	Get in position										
		,	1	Reach	Reach to grab handle	adle									
		+	V.	Grasp	Grasp handle		The state of the s	-							
		+	M8B10	Tilt	Tilt dispenser back	BCK									
Return leg to position	IM12 11	+									-				
	5	+	W3PO	Walk	Walk backward						1				
Cart to normal position	M6B10 15	15.7	M8B10								1				
Release	NL1	2.0	HL.1	Release	8										
	228	-													
Walk to pallet for next banding															
	18	18.6 T	TBC1	TOWER	Toward banding										
	30	30.0	W2P	Walk	Walk between pallet and dispenser	let and di	Spenser								
	841	9.84													
			CONVERSION									CONVERSION	_		
ELEMENT DESCRIPTION	THE		OCCUPATION AL	ALLOWANCE.	TIME	OCCURRENCES PER PRES OR CYCLE	TOTAL	ě.	ELEMENT DESCRIPTION		THE	7	ALLOWANCE ALL	TIME PECE OR	TIME
Randing break, bend end and aside	130.8		.001208	158	.00139	1	.00139 V	N N	Remove crimper and band stretcher to	+	38.7	.000387	15% .00	.00045 1	. 00045
Banding dispenser relocate for next band 228.8	band 228.	1	.002288	158	.00263	1	.00263	A	band dispenser after last banding		1				+
Walk to pallet for next banding	9.87		.00c/µ86	154	95000.	7	95000.								-
		-	-		-		-	-	And the same of th		-	-			

ELEMENT ANALYSIS

ELEMENT ANALYSIS (Cont'd)

	ELEMENT ARALISAS				
Element Description	Classification	Influencing Factor	Element Description	Classification	Influencing Factor
A Stretcher, crimper, get and	Constant	Stretcher and crimper will	L Seal, get and add to band	Constant	Motion pattern does not wary.
place on load		always be in same location (load up to \$45" high)	M Band complete tightening	Constant	Same as El. above
B Seals, get several and place on load	Constant	Motion pattern will vary some- what but an average motion	N Crimper, get crimp and crimp seal	Constant	Same as El. above
		pattern has been used. Generally four seals will be	P Crimper, remove and aside	Constant	Same as El. above
		obtained as an average. How- ever, three grasps have been	Q Stretcher band, remove	Constant	Same as El. above
		allowed because two seals will interlock slightly and both can be grasped simul-	R Banding, break, bend end and aside	Constant	Same as El. above
C Thread banding through pallet		(The length of band will vary	T Banding dispenser relocate	Constant	
(Table	Variable	(with neight of load.			number of steps has been used.
20" High 50" High 50" High	Variable Variable Variable		U Walk, to pallet for next band	Constant	An average motion pattern has been used.
opposite end		Pallet will always be $\mu 0^{\prime\prime} \propto \mu \delta^{\prime\prime}$ Slight variation in walking distance but average is used.	V Crimper, band stretcher, remove and aside after last banding	s Constant	Motion pattern does not vary.
E Return to original end of pallet with band	Constant	Same as El. D			
F Place end of band and loop together	Constant	When load is over 15" high the motion pattern is always the same. When load is less than 15" then an arise from bend does not occur but a 24" move is limiting. The difference in total time for the two elements would be less than four TMUs. The element has been called a Constant and the higher time value has been used.			
G Stretcher, get and place under band (load 10* to 45* high)	Constant	Motion pattern is constant.			
H Stretcher, get and place under band (load 45" to 65" high)	Constant	Motion pattern is constant.			
J Tighten banding, remove slack and add seal.	Constant	Average motion pattern has been used.			

SYNTHESIS

CONSTANT PER BAND (Load up to 45" high)

$$K1 = D + E + F + G + J + M + N + P + Q + R + T - U$$

.00106 + .00106 + .00092 + .00098 + .00171 +

.00066 + .00135 + .00036 + .00093 + .00139 +

.00263 + .00056 = .01361

CONSTANT PER BAND (Load 45" to 65" high)

$$K2 = D + E + F + H + L + M + N + P + Q + R + T + U =$$

.00106 + .00106 + .00092 + .00124 + .00232 +

.00066 + .00135 + .00036 + .00093 + .00139 +

.00263 + .00056 = .01448

CONSTANT PER PALLET (Load under 45" high)

K3 = A + B + V

.00059 + .00106 + .00045 = .00210

ELEMENT C IS A VARIABLE. The motion pattern of pushing the band through the pallet will vary with the length of the band required to encircle the pallet. The length of the band required is determined by the perimeter (vertical) of the load. Since the width of the pallet (and the load) may be considered constant, the perimeter will vary only with the height of the load. Therefore the motion pattern of this element and the time varies directly with the height of the load.

The relationship of time and the height of the load is shown on Table I. The five MTM studies for element C have been plotted on the graph as shown on Table I using the Height of the Load as the abscissa or independent variable and Time in Hours as the ordinate for dependent variable.

SYNTH

TIME REQUIRED TO BAND PALLET

Loads 10 inches to 45 inches in height

K3 + X(K1 + Table I)

.00210 + X(.01361 + Table I)

Where X = numer of bands per pallet

Loads 45 inches to 65 inches in height

K3 + X(K2 + Table I)

.00210 + X(.01448 + Table I)

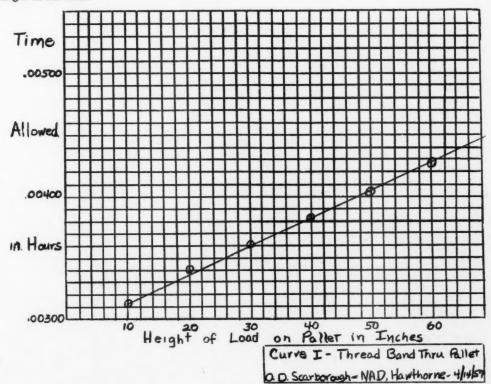
Where X = number of bands per pallet

INSPECTION

Banding must be taut and must not give more than 1 1/2" under a 25 pound pull. Crimped seal must be secure to prevent slippage of the band.

PAYMENT:

Day work.



Chapter News

The April meeting, MTM Association of Ohio, was held at the Hotel Alms, Cincinnati.

Major R. D. Struble, Air Materiel Command, Wright Patterson Air Force Base, presented a film on logistics problems faced and solved by the Air Force. He also discussed various management techniques employed to develop and maintain a high level of efficiency by the personnel of the Air Materiel Command, both military and civilian.

MTM Training

A new impact highlighted the second MTM course at Norton Air Force Base in San Bernardino, California. Among the 17 graduates were Mrs. Millie Rose and Mrs. Philomene Spisak, both management analysts in the Industrial Engineering Division of the Directorate of Supply and Services. Mrs. Rose and Mrs. Spisak are among the first Air Force Women to become registered MTM practitioners. Both placed in the upper half of the class in the examination scores.

The MTM courses at Norton are conducted by Mr. Norman F. Bohren, Chief, Production Control Branch in the Industrial Engineering Division of the Supply and Services Directorate. Mr. Bohren is one of the few licensed MTM instructors in the Air Force. With the new graduates, Norton Air Force Base now has 34 MTM certificate holders in the Industrial Engineering Divisions of the Supply and Maintenance Directorates.

Lt. Col. L. E. Heath, Deputy Director for Plans, Procedures and Quality, Directorate of Supply and Services, presented the coveted certificates at an Officers' Club luncheon in April 1958.

LADIES FIRST — Lt. Col. L. E. Heath presents certificates to Mrs. Philomene Spisak (left) and Mrs. Millie Rose, who are among the first Air Force women to become MTM practicioners. Mr. Norman Bohren instructed the MTM courses at Norton Air Force Base in San Bernardino, California. Seventeen graduates received certificates at the Officers' Club luncheon.





STANDING (from left):
George L. Hagner
Irven Hunter
A. T. Christensen
David E. Howard
Philomene C. Spisak
Norman Bohren (instructor)
Millie C. Rose
Early R. Hartley
Robert T. Smith
Trygve F. Dahle.

KNEELING:

James H. Kensinger Charles W. Ashford Donald R. Brown Robert F. Bradley Emerson Symonds Lewis H. Winkle.

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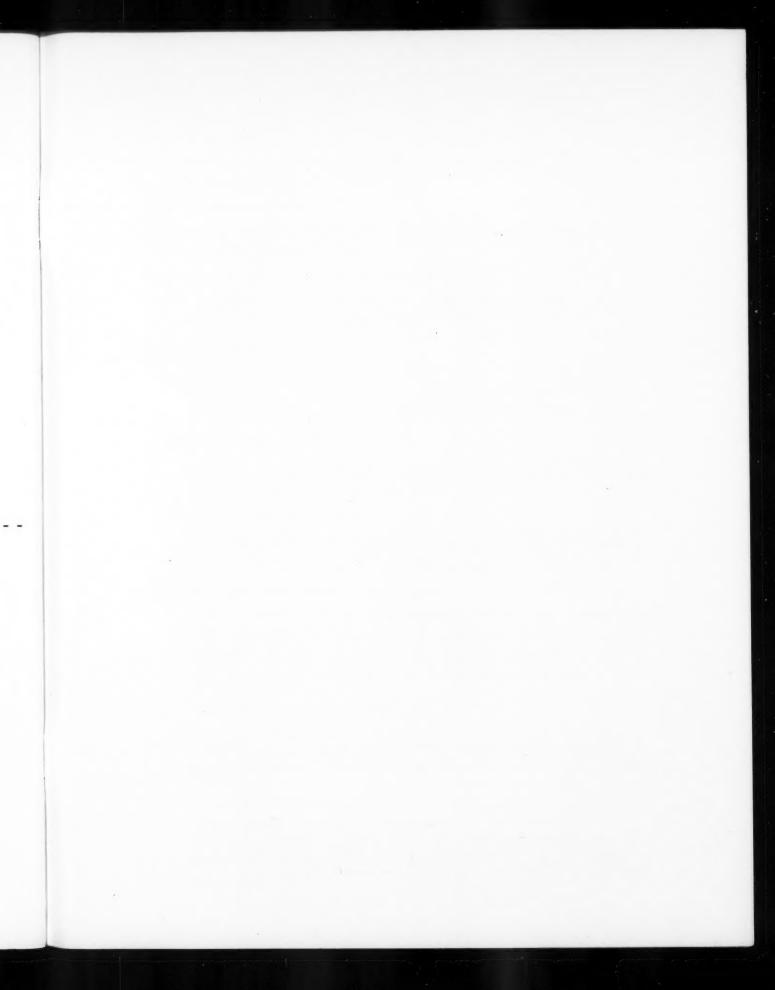
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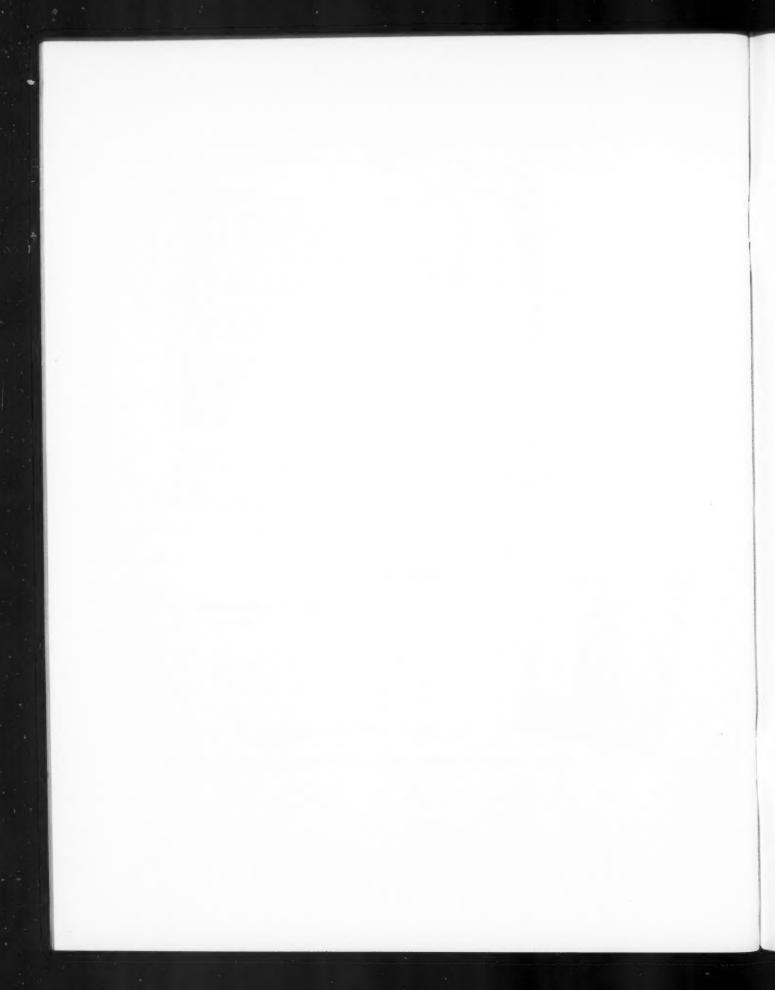
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This report contains a preliminary study of the element disengage. While it is still classified as tentative, the report contains some extremely interesting conclusions on the nature and theory of this element.

R.R. 102 Reading Operations

The first step in the use of MTM for establishing reading time standards is contained in this report. In addition, the report contains a synopsis of the work done in this field by 11 leading authorities.

R.R. 104 MTM Analysis of Performance Rating Systems

A talk presented at the SAM-ASME Time and Motion Study Conference, April 1952. It contains an analysis of performance rating systems and various performance Rating Films from an MTM standpoint.

R.R. 105 Simultaneous Motions

This report represents almost two man-year's work on a study of Simultaneous Motions. It is a final report of the Simultaneous Motions project undertaken by the MTM Association. While it does not purport to provide complete and exhaustive answers to all problems in the field of Simultaneous Motions, it presents a great deal of new and valuable information which should be of interest to every MTM practitioner.

R.R. 106 Short Reaches and Moves

This report contains an analysis of the characteristics of Reaches and Moves at very short distances. It develops important conclusions concerning the application of MTM to operations involving these short distance elements.

R.R. 107 A Research Methods Manual

The research activity of the Association has developed an effective and comprehensive set of methods for carrying on research in human motions. This report details the major techniques used. Adequate sources of motion data, film analysis, data recording, and statistical methods of analysis are among the topics discussed.

R.R. 108 A Study of Arm Movements Involving Weight

In this report, the results of a large investigation into the effect of weight on the performance times of arm movements are presented. While more effective means of determining correct time allowances for moving weights are given, the comprehensive discussion of the whole area of weight phenomena is probably of more fundamental importance. The effect of such conditions of performance as the use of one or two hands, sliding vs. spatial movements, and male and female performance are among the topics presented.

R.R. 109 A Study of Positioning Movements

I. The General Characteristics. II. Appendix.

This report, the first of two position reports, defines "positioning movements and the interrelation of component movements." The study is limited to the laboratory analysis, and contains an appendix dealing with several subjects outside the major objectives.

R.R. 110 A Study of Positioning Movements

III. Application to Industrial Work Measurement.

This report, the second on position, relates the results of the position research to the field of application. This study deals with actual industrial operators and work measurement tools, and the evolution of an improved and more efficient technique for controlling and improving manual activity through better understanding of positioning movements.

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